Information Crossfile

SEVEN THOUSAND YEARS OF LAND CONQUEST AND THE LAND ETHIC

Typically, "Information Crossfile" articles summarize new research, technology, or other information reported in journals that is deemed useful to resource managers. In contrast to this norm, however, two rather old publications are mentioned here and are worth a fresh look. The first one (published posthumously in 1949) is *A Sand County Almanac* by Aldo Leopold. The second, published in 1953 about work conducted in 1938 and 1939, is more obscure (but still available through the Natural Resources Conservation Service): *Conquest of the Land through 7,000 Years* by Walter C. Lowdermilk. Leopold worked for the USDA Forest Service, Lowdermilk for the then Soil Conservation Service, so their experiences as government employees may be familiar to NPS resource managers; however, their perspectives are extraordinary, particularly in light of their pertinence to present-day land management.

Today, the Institute for Scientific Information estimates the duration of a publication's usefulness by the frequency of citations in published literature. A usual decay curve of citation frequency shows a half-life of approximately six years; that is, after publication, citations build for five or six years then taper off. For *A Sand County Almanac*, however, a contrasting curve appears: almost no citations occurred for more than a decade, then citations have been rising consistently for the subsequent 50 years (Leopold 2004). It is evident, then, that Aldo Leopold's book is having an impact over a long period of time.

Now consider a passage from Lowdermilk (1953):

> A just relation of peoples to the earth rests not on exploitation, but rather on conservation—not on the dissipation of resources, but rather on restoration of the productive powers of the land and on access to food and raw materials. If civilization is to avoid a long decline ... society must be born again out of an economy of exploitation into an economy of conservation.

Using examples from lands of ancient civilizations and our own civilization, the report calls into question the meaning of progress and development. But it also is a realization that peoples of the past were not somehow better caretakers of Earth's resources. For example, the first records of salinization caused by irrigation are about 5,000 years old and come from present-day Iraq (ancient Mesopotamia), the crib of all civilization. The present applicability of this 65-year-old soil survey is astounding.

Therefore, the assumption that we humans have lost our intuition about how to care for the land and that primitive peoples were more adept is probably false. We are undoubtedly still learning, and the lessons in Lowdermilk (1953) and the land ethic in Leopold (1949) continue to provide guidance. —*K. KellerLynn*

References

Leopold, A. 1949 (reprint, 1966). A Sand County almanac with essays on conservation from Round River. Oxford University Press and Ballantine Books, New York.

Leopold, A. C. 2004. Living with the land ethic. BioScience 54(2):149–154.

Lowdermilk, W. C. 1953. Conquest of the land through 7,000 years. Agriculture Information Bulletin 99. Natural Resources Conservation Service, Washington, D.C.

IN SUPPORT OF BASIC RESEARCH IN NATIONAL PARKS

National parks in the United States have a well-documented history of indifference, if not hostility, in support of basic research. Numerous external reviews have criticized the lack of institutional support for science, blaming it in large part on the traditional emphasis of the National Park Service on tourism and recreation management. However, according to Parsons (2004), recent efforts to improve the support for science in U.S. national parks have been most encouraging. These include a long-sought congressional mandate to support research; a major budget initiative to support scientific understanding and management of park resources, and to improve research facilities; leadership in the establishment of a network of university-based cooperative units; and partnering with private organizations to support programs that fund Ph.D. undergraduate and graduate students, postdocs, and sabbaticals in national parks.

Six programs are particularly noteworthy and highlight, in the words of NPS Associate Director Michael Soukup, "the mutualism between park management and scientists" (Soukup 2004) in attaining the objectives of both "science for parks" and "parks for science."

Canon National Parks Science Scholars Program for the Americas

By providing support to Ph.D. students throughout the region (i.e., Canada, the United States, Mexico, the countries of Central and South America, and the countries of the Caribbean), the Canon National Parks Science Scholars Program for the Americas strives to develop the next generation of scientists working in the fields of conservation, environmental science, and national park management. The program is a collaboration among Canon U.S.A., Inc., the American Association for the Advancement of Science, and the U.S. National Park Service. More information is available at http://www1.nature.nps.gov/canonscholarships/2004_App_Guide.htm.

Cooperative Ecosystem Studies Units (CESUs)

As part of a network of cooperative research units established to provide research, technical assistance, and education to park managers, each CESU is structured as a working collaboration among federal agencies and universities. The network provides resource managers with scientific research, technical assistance, and education. More information is available at http://www.cesu.org/cesu/.

GeoScientists-in-the-Parks (GIP)

Facilitated through the GIP Program, experienced earth science professionals and students work with park staffs to understand and protect geologic processes and features in the National Park System. The range of needs that GIPs address are fundamental research, synthesis of scientific literature, mapping, GIS analysis, inventorying, site evaluations, developing brochures and informative media presentations, and educating staffs. More information is available at http://www2.nature.nps.gov/geology/gip/.

National Parks Ecological Research (NPER) Fellowship Program

Through funding from the Andrew W. Mellon Foundation, the National Park Service, National Park Foundation, and Ecological Society of America host the NPER Fellowship Program, which encourages and supports outstanding post-doctoral research in ecological sciences related to the flora of the U.S. National Park System. Each year, up to three fellowships are granted to researchers who have recently completed their Ph.D. More information is available at http://esa.org/nper/.

Research Learning Centers

The National Park Service developed Research Learning Centers to facilitate research efforts and provide educational opportunities for all people to gain new knowledge about national parks. These centers are places where science and education come together to preserve and protect areas of national significance. They have been designed as public-private partnerships that involve organizations and individuals including researchers, universities, educators, and community groups. More information is available at http://www1.nature.nps.gov/learningcenters/.

Sabbatical in the Parks

The National Park Service created the Sabbatical in the Parks program to assist in arranging faculty sabbaticals to conduct research and other scholarly activities in the National Park System. Outcomes are usable knowledge for NPS management and advancement in science and human understanding. More information is available at http://www1.nature.nps.gov/Sabbaticals/. *—K. KellerLynn*

References

Parsons, D. J. 2004. Supporting basic ecological research in U.S. national parks: challenges and opportunities. Ecological Applications 14(1):5–13.

Soukup, M. 2004. A careerist's perspective on "Supporting basic ecological research in U.S. national parks." Ecological Applications 14(1):14–15.

Protecting species in the face of changing climate

Since the late 1980s, we have commonly heard reports that human activities are increasing the atmospheric concentrations of greenhouse gases—which tend to warm the atmosphere—and, in some regions, aerosols—which tend to cool the atmosphere. Scientists project that these changes in greenhouse gases and aerosols, taken together, lead to regional and global changes in climate and climate-related parameters such as temperature, precipitation, soil moisture, and sea level (Watson et al. 1996). However, how these changes will affect the day-to-day activities of NPS resources managers is just now coming to light.

Resource managers are faced with the significant challenge of protecting species in the face of changing climate. This challenge is particularly formidable because species conservation is generally associated with protection strategies linked to particular pieces of property such as national parks. In the United States and other nations around the world, national parks increasingly are being used to serve critical roles in species protection. However, if global climate change alters the geographic distribution of habitats and wildlife species, the ability to retain and protect species within designated boundaries is highly uncertain.

Recent empirical studies strongly suggest that wildlife species are already responding to recent global warming trends with significant shifts in range distribution (generally northward) and phenology (e.g., earlier breeding, flowering, and migration). In response to these studies, researchers have begun to use the predictive power of general circulation models (GCMs) to anticipate large-scale and long-term effects of climate change as entire complex communities shift. In the models, predicted gains and losses of species from selected parks were strictly a function of expected vegetation shifts due to climate change (Burns et al. 2003). A species was recorded as potentially present in a park, under the future climate scenario of doubled levels of CO_2, if acceptable habitat for that species was predicted to occur within park boundaries.

Current models of global climate change indicate that eastern and western ecosystems within the United States will be impacted differentially. Therefore, researchers of this study stratified the United States into eastern and western ecoregions (divided by the Mississippi River) to ensure equitable representation of eastern and western parks. They then chose eight U.S. national parks from the larger pool of parks within these regions: Acadia, Big Bend, Glacier, Great Smoky Mountains, Shenandoah, Yellowstone, Yosemite, and Zion. Three factors constrained their choice of national parks: (1) geographic extent of climate change predictions, that is, the continental United States; (2) the regional availability of parks, that is, more western than eastern U.S. national parks; and (3) the availability of detailed mammalian species lists for each park.

Their results suggest that the effects of global climate change on wildlife communities may be most noticeable not as a drastic loss of species from their current ranges, but as a fundamental change in community structure as species associations shift because of influxes of new species. As shifting species forge new ecological relationships with one another and with current park species, the character of species interactions and fundamental ecosystem processes stands to become transformed in unforeseen ways. For example, an influx of new species may alter existing competitive interactions and influence trophic dynamics with changes in predator-prey interactions. Also, climate warming is likely to result in phenological shifts, including changes in spring breeding dates, flowering, and bud emergence, which can further disrupt current species associations. In some cases, shifting species assemblages may lead to irreversible state changes, in which the relative abundance of species in different trophic levels can be radically altered. Moreover, the outcome of these new species interactions may be particularly difficult to predict because of the rapid pace of change expected and the potential for nonlinearities that may emerge, for example, as a consequence of altered trophic interactions. —*K. KellerLynn*

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References

Burns, C. E., K. M. Johnson, and O. J. Schmitz. 2003. Global climate change and mammalian species diversity in U.S. national parks. Proceedings of the National Academy of Sciences of the United States of America 100(20):11,474–11,477. Available at http://www.pnas.org/cgi/content/full/100/20/11474 (accessed 2 August 2004).

Watson, R. T., M. C. Zinyowera, R. H. Moss, and D. J. Dokken. Climate change 1995—impacts, adaptations, and mitigation of climate change: scientific-technical analyses. Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel on Climate Change. Published for the Intergovernmental Panel on Climate Change. Cambridge University Press, New York.

Twinkle, twinkle, little star. How I wonder *where* you are?

The stars in the nighttime sky are disappearing. One here, one there—a hardly noticeable process that began over large metropolitan areas and is now spreading to nearly every corner of civilization. Even remote areas are being exposed to increased illumination from "sky glow" that appears at night over urban areas and obscures our view of stars and other astronomic phenomena. Investigators predict that the most noticeable effects of light pollution will occur in those areas close to natural habitats (Longcore and Rich 2004). This may be near wilderness where summer getaways are built, along the expanding front of suburbanization, near wetlands and estuaries that are often the last open spaces in cities, or on the open ocean, where cruise ships, squid boats, and oil derricks light the night.

As faint celestial objects billions of miles away began to disappear from their telescopes, astronomers were the first to notice what we are stealing away from ourselves. Now other scientists, primarily ecologists, and citizens are realizing the effects of light pollution in deadly ways. The poster child for this issue is probably hatchling sea turtles, which are protected under the Endangered Species Act of 1973. These baby reptiles generally break free of their shells under the cover of darkness and then waddle into the surf as soon as possible to avoid predation. Normally they orient themselves by scanning the horizon and heading for celestial lights such as the moon and stars reflecting off the sea. Artificial lighting on beaches and roadways near nesting areas, however, often confuses hatchlings and causes them to crawl inland instead (Schaar 2002). According to Kristen Nelson of the Florida Department of Environmental Protection, thousands of hatchlings are disoriented in this way every year. In 1998, for example, marine turtle permit holders reported 19,970 hatchlings as disoriented (Nelson 2000). Many hatchlings die from dehydration, are eaten by predators such as fire ants and ghost crabs, or are run over by cars if they wander onto nearby roadways. Those that do make it to the water may have a decreased chance for survival because of wasted energy resources.

In addition to causing disorientation, ecological light pollution has demonstrable effects on the behavior of most organisms in natural settings (e.g., insects, migrating toads and salamanders, birds, bats, and fish). Changed behaviors—orientation/disorientation and attraction/repulsion—in altered light environments may in turn affect foraging, reproduction, migration, and communication (Longcore and Rich 2004). Moreover, the cumulative effects of behavioral changes induced by artificial night lighting on competition and predation have the potential to disrupt key ecosystem functions (Longcore and Rich 2004). The consequence of ecological light pollution on aquatic invertebrates illustrates this point. Many aquatic invertebrates, such as zooplankton, move up and down within the water column during a 24-hour period. This regular vertical migration, called "diel vertical migration," presumably results from a need to avoid predation during lighted conditions; therefore, most zooplankton forage near water surfaces only during dark conditions (Gliwicz 1986). Artificial illumination decreases the magnitude of diel migrations, both in the range of vertical movement and the number of individuals migrating. Researchers hypothesize that this disruption of diel vertical migration may have substantial detrimental effects on ecosystem health. With less zooplankton migrating to the surface to graze, algae populations may increase. Such algal blooms would then have a series of adverse effects on water quality (Moore et al. 2000).

In *Management Policies 2001*, the National Park Service acknowledges the roles that light and dark periods and darkness play in natural processes, and in cooperation with park visitors, neighbors, and local governments, it strives to prevent loss of dark conditions and natural night skies. However, obstacles for the National Park Service include a lack of awareness of light pollution as a threat to wilderness values and cultural heritage, an absence of baseline formation about this resource, and inefficient facility lighting (Moore and Duriscoe 2002). Possibly conventional wisdom that light reduces crime also serves as a stumbling block. Most crime, however, actually occurs during the day, or inside buildings, and the paucity of data precludes any definitive statement regarding the relationship of lighting and crime (International Dark-Sky Association 1990). Furthermore, "dark campus" programs across the country have shown that darkness actually reduces crime, in particular vandalism, and saves money (e.g., decreased energy costs and reduced repairing and cleaning of damage) (International Dark-Sky Association 2000). On the other hand, studies indicate that lighting decreases the fear of crime; it makes us feel safe outside at night. Yet, the real task for resource and facility managers is to make visitors and staffs not just feel safe, but be safe, for example by providing good lighting for nighttime travelers around headquarters, housing areas, visitor centers, and entrance stations. Yet visitor and staff safety must be achieved while protecting the natural behaviors of wildlife and preserving natural night skies. This means that the National Park Service needs effective and efficient lighting in developed areas. Good visibility is the goal (not just wasting resources on lighting a vacant parking lot or perhaps lighting a criminal's way), and good lighting can help. Poor lighting compromises human safety, natural wildlife behaviors, and the natural night sky.

The International Dark-Sky Association (1996) provides some solutions that minimize light pollution without compromising safety or utility:

1. Use night lighting only when necessary. Turn off lights when they are not needed. Timers can be very effective. Use the correct amount of light for the need, not overkill.

2. Where light is needed, direct it downward. The use and effective placement of well-designed fixtures will achieve excellent lighting control. When possible, retrofit or replace all existing fixtures of poor quality. In all cases, the goal is to use fixtures that control the light well and minimize glare, light trespass, light pollution, and energy use.

3. Use low pressure sodium (LPS) light sources whenever possible. These are the best possible light sources to minimize adverse effects on astronomical activities and are the most energy efficient light sources that exist. Areas where LPS light sources are especially good include street lighting, parking lot lighting, security lighting, and any application where color rendering is not critical.

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Recommendations

1. Users of the NWI maps should trust that the wetlands and deep-water habitats shown probably exist. However, they should expect that the maps may have omitted nearly half as many additional wetlands.
2. Users should be suspicious of the accuracy of taxonomy on the maps. However, the Lacustrine sites are the most trustworthy.
3. For applications where accuracy is critical, such as planning of research or monitoring projects or preparing for Section 404 compliance of the Clean Water Act, on-site delineation or evaluation is essential. The maps should be used only as an indicator of what to expect.
4. Managers wishing more detailed information about this survey should see Werner (2003).

Acknowledgments

Pat Lineback initiated this project and secured funding from the NPS Water Resources Division. Sylvia Haultain, Jennifer Akin, and Julia Evans provided field oversight and support for the crew. Elizabeth Van Mantgem, Allison Roll, Cheryl Bartlett, and various members of the vegetation mapping crew collected the data. Joel Wagner provided valuable suggestions for improving this manuscript.

References

Cowardin, L. W., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. Report FWS/OBS-79/31. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Mitsch, W. J., and J. G. Gosselink. 1993. Wetlands. Van Nostrand Reinhold, New York, New York.

National Park Service (NPS). 2001. Management Policies 2001. NPS, Washington, D.C.

U. S. Fish and Wildlife Service (USFWS). 2003a. National Wetland Inventory. Overview page. USFWS, Washington, D.C. Available at http://wetlands.fws.gov/overview.htm (accessed 23 October 2003).

U. S. Fish and Wildlife Service (USFWS). 2003b. National Wetland Inventory. Wetlands and deepwater habitats classification page. USFWS, Washington, D.C. Available at http://www.nwi.fws.gov/atx/atx.html (accessed 23 October 2003).

Werner, H. 2003. Assessment of National Wetland Inventory maps for Sequoia and Kings Canyon National Parks, 2000–2001. Sequoia and Kings Canyon National Parks, Three Rivers, California: unpublished report.

About the author

Harold Werner *is the wildlife ecologist at Sequoia and Kings Canyon National Parks. He can be reached at 559-565-3123 or harold_werner@nps.gov.*

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4. Avoid development near existing observatories, and apply rigid controls on outdoor lighting when development is unavoidable. —*K. KellerLynn*

References

Gliwicz, Z. M. 1986. A lunar cycle in zooplankton. Ecology 67:883–897.

International Dark-Sky Association (IDA). 1990. Security lighting: let's have real security, not just bad lighting. Information sheet 24. IDA, Tucson, Arizona. Available at http://www.darksky.org/infoshts/is024.html (accessed 10 August 2004).

International Dark-Sky Association (IDA). 1996. The problem with light pollution. Information sheet 1. IDA, Tucson, Arizona. Available at http://www.darksky.org/infoshts/is001.html (accessed 10 August 2004).

International Dark-Sky Association (IDA). 2000. Dark campus programs reduce vandalism and save money. Information sheet 182. IDA, Tucson, Arizona. Available at http://www.darksky.org/infoshts/pdf/is182.pdf (accessed 10 August 2004).

Longcore, T., and C. Rich. 2004. Ecological light pollution. Frontiers in ecology and the environment 2(4):191–198.

Moore, C., and D. Duriscoe. 2002. Monitoring and preserving dark skies. Page 35 in J. Selleck, editor. Natural Resource Year in Review—2002. Publication D-2283. National Park Service, Denver, Colorado, and Washington, D.C.

Moore, M. V., S. M. Pierce, H. M. Walsh, S. K. Kvalvik, and J. D. Lim. 2000. Urban light pollution alters the diel vertical migration of *Daphnia*. Proceedings of the Verh Internationale Vereinigung für Limnologie 27:779–782.

Nelson, K. 2000. Turtles and outdoor lighting in Florida. Information sheet 29. International Dark-Sky Association, Tucson, Arizona. Available at http://www.darksky.org/infoshts/is029.html (accessed 10 August 2004).

Schaar, T. 2002. Artificial lighting and wildlife—a moth to a flame. Information sheet 54. International Dark-Sky Association, Tucson, Arizona. Available at http://www.darksky.org/infoshts/is054.html (accessed 10 August 2004).

Reports available online

Two new reports on recently completed inventories are posted on the Web site for the Northeast Region: "Comprehensive inventory of birds and mammals at Fort Necessity National Battlefield and Friendship Hill National Historic Site" and "Inventory of intertidal habitat: Boston Harbor Islands, a national park area." These can be viewed at and downloaded from http://www.nps.gov/nero/science. —*B. Blumberg*